

HELICOPTER TRAINER

Instructions for assembly, operations and maintenance.

MAY 1968

For Serial Numbers D2001 To D2500

Amusement Engineering Corp.
Omaha, Nebr.

TABLE OF CONTENTS

	PAGE:
Introduction	1.
Setting Up Helicopter	1.
Access Panels	1, 2.
Operation	2, 3, 4.
Sequence of Operations	4, 5.
Trouble Shooting & Repair	5, 6.
Illustrations	7.
How To Make Adjustments	6, 8, 9, 10, 11.
Specific Repair Procedures	11, 12, 13, 14, 15, 16.
Moving Procedures	16.
Parts List	16, 17, 18.

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INTRODUCTION

Because this machine is different it is essential that your personnel follow our maintenance and operating instructions. A repairman who thinks he doesn't have to read or follow these instructions will probably get into trouble. If your operation area is spread out and you need more instruction booklets, let us know. We'll be glad to send some.

SETTING UP HELICOPTER

Tilt Helicopter Trainer forward (front of machine to floor) until top front panel rests on floor, placing pad on floor to protect machine from marring on contact with floor, then remove shipping wood base. Now, install legs on all four corners of Helicopter Trainer.

NOTE: (Access to the interior is controlled by the key to the coin drop door. See "access panels" section for instructions on opening up the Machine for set-up or maintenance).

Remove the back panel. You will find a counterweight taped to the inside of the control linkage channel. Remove the weight and install it on the helicopter boom according to the instructions contained in the second paragraph of the section on "operation". Push the power cord stored inside the base out through the hole with a rubber grommet on the bottom of the cabinet. You're ready for business.

ACCESS PANELS

The key to the coin drop door locks up the whole machine yet three panels are readily removable without tools to expediate maintenance. The following instructions will make it easier for the repairman to locate and remove these panels.

Pack Panel Reach in through the coin drop door and locate a $\frac{1}{4}$ " steel

ACCESS PANELS - continued

rod handle (aluminum color, if you're looking) about one foot back and to the right of the door. Lift the handle straight up about one inch and then pull towards you. It will slide back about one inch. Lift the back panel straight up and out of the channel. Do not push in on the panel or you may force the background photograph up against the roof and scratch it. The best procedure is to pull the panel towards you as you slide it up.

Control Panel Reach in through the coin drop door and feel for a wing nut in the upper center of the front panel. Remove the nut. Grasp the control panel on both sides and slide it towards you and then lift up when it's all the way out.

Bottom Panel Remove the back panel. Grasp the up-turned edge of the bottom panel and pull it out.

OPERATION

Follow the steps contained in this section to get reliable operation, long life and highest profits.

Every "Helicopter Trainer" is tested and adjusted for optimum performance before it's crated for shipment. When set up according to instructions, adjustments should not be required.

The first step in preparing your Trainer for operation is to release the Helicopter from its tied down position on the board. Remove the plastic foam strips, or pads, from the bottom of the runners. Next, install the counterweight. It is the olive drab cylindrical steel slug with a hole the length of its center. Remove the $\frac{1}{4}$ "x 20 nut from the end of the boom. Screw the counterweight onto the boom, putting the end without threads towards the center. Screw it on until the inside end lightly touches the collar. Next step is to lock the counterweight in this position by holding the weight stationary, and by replacing the $\frac{1}{4}$ "x 20 nut snug against

OPERATION - continued

counterweight. Only a moderate amount of force is necessary. The position of the collar was set at the factory to give you correct balance with the counterweight touching it. Don't move the collar unless absolutely necessary. Additional tests and checks are not required unless the helicopter is not operating correctly.

The best test for proper operation is to fly the full pattern trying to make all contact points. Both controls should operate smoothly and helicopter movement should be free with response proportional to control movements. A skilled operator should be able to earn 450 to 500 points during one play when the machine is operating properly and the difficulty index is set at the easiest point.

Lubrication is essential to reliable, trouble free, and economical operation. About every 2,000 plays lubricate the universal joint and pivot points by application of a light grease with molybdenum disulphide added such as that used for fishing reels.

Do not oil motor.

About every 6 months the same light grease should be applied to all points of movement in the control linkage. The two ball bearings in the vertical pivot shaft housing should be lubricated with a light oil.

Adjusting the Difficulty Index is very simple and can prove to be profitable in some cases. When installed in locations with high turnover traffic such as airports, bus stations, etc., the difficulty index should be set low so that relatively inexperienced people can gain a higher degree of success. In locations with high ratio of repeat customers such as neighborhood bars, bowling alleys, more difficult settings will encourage more repeat plays and keener competition between players. To adjust difficulty index, rotate the fixed contact points horizontally so that more or less area of the contact can be touched by the wand. See illustration #1.

OPERATION - continued

Care should be taken to keep difficulty index incremental - that is, #3 contact should be more difficult than #2, #4 should be harder than #3. Never make one more difficult than any that follow. After adjusting contact points be sure to take the trouble to play the game at least twice to make sure that all can still be reached by the wand in normal operation.

SEQUENCE OF OPERATIONS

1. When plugged into power source.
 - a. Dome light should be on.
 - b. Coin lock-out solenoid energized.
 - c. Power transformer on.
2. When coined, the following occurs:
 - a. Coin switch closed momentarily
 - b. Coin trip coil (#4) energized (lock down) which starts counter reset motor to zero counter.
 - c. Timer reset solenoid energized.
 - d. Power applied to scenic and post lights.
 - e. Control handles unlock.
 - f. Helicopter motor control power on.
 - g. Coin reset coil (#5) energized which opens coin trip (#4) and starts forward running motor on counter.
 - h. #1 position should be "on".
3. When position #1 is hit.
 - a. Hit relay (#2) is energized.
 - b. Bell rings through hit relay contact points.
 - c. Control unit release coil is energized which changes landing position (check point) and adds score.
4. When the timer shuts down the game.

SEQUENCE OF OPERATIONS - continued

- a. The timer relay (#3) opens which energizes the coin lock-out coil and de-energizes the control lock solenoid.

TROUBLE SHOOTING AND REPAIR

The scoring and control mechanism are very simple and straight forward and with the attached wiring diagram the average repairman will have no difficulty in trouble shooting and fixing problems in this area. However, trouble shooting the helicopter and related controls involve information that is not common knowledge so we will spend some time going over procedures in these areas.

First and foremost, the repairman must not consider the boom assembly in the same light as the float arm in a toilet tank even though they look somewhat alike. The precise location of the center of gravity of the whole rotating assembly is of fundamental importance and the product of considerable precision in manufacture. The control linkage is also of considerable refinement in both design and manufacture and experimental bending or modification will most likely produce unsatisfactory results.

Over-heating or burning out helicopter motors can be caused by either improper balance, binding linkage or both. For example, suppose the boom pivot is binding at lower angles. If the repairman notices that the helicopter doesn't land when the power is cut off, he could correct this problem by moving the weight inward, making the helicopter (in effect) heavier so that it overcomes the bind and lands properly. Of course, with the helicopter now heavier, he will have to increase power to get the required altitude. Now the motor gets too hot.

The helicopter motors, though small, are very reliable and have gone well over 15,000 plays without repair, adjustment or lubrication. Don't get mad at the motor if it overheats, check for proper balance and binding linkage.

TROUBLE SHOOTING AND REPAIR - continued

Binding in vertical movement of the helicopter may be caused by problems in the universal joint or pivot points in the aluminum block on top of the helicopter or in the central pivot. First clean and lubricate. Next check clearances and alignment. If it appears that the boom is trying to twist, causing friction on the washer between the boom and vertical pivot shaft, very carefully bend the counterweight end of the boom sideways to bring the center of gravity in line with the center of the horizontal pivot. See illustration #2.

If vertical movement is free and easy through the full range, yet too much power is required to get the desired altitude, it is possible the counterweight boom has been bent downward, moving the center of gravity too far below the pivot. Correct for this by bending the boom upwards as shown in illustration #3.

Binding in forward or backward movement of the helicopter is most likely caused by dirt in the vertical pivot shaft ball bearings. Remove and clean them in solvent, blow out with compressed air, oil, (very light) and replace. If this doesn't correct the problem, put in new bearings.

HOW TO MAKE ADJUSTMENTS

1. Helicopter tilt stop.
 - a. A tilt stop has been installed on the outer end of the boom to prevent the helicopter from tilting so far that the rotor blades contact the boom.

Normally, rotor blades should clear the boom at least $\frac{1}{4}$ " when the rotor shaft touches the tilt stop.
 - b. When adjustment is necessary, bend the stop arm so that the cross bar is close or lightly contacts the rotor shaft when the helicopter is sitting flat on the landing pad (up to $\frac{1}{64}$ " clearance o.k.).

ILLUSTRATIONS

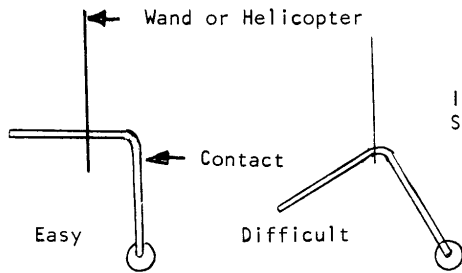
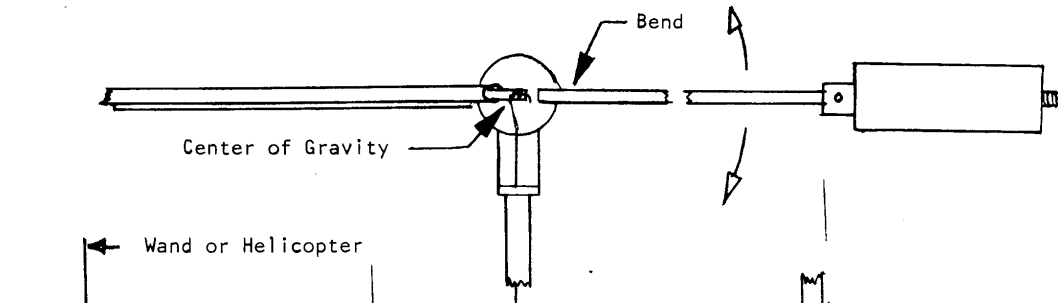


Illustration #1
Top View

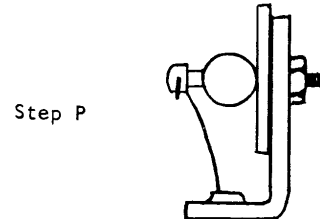
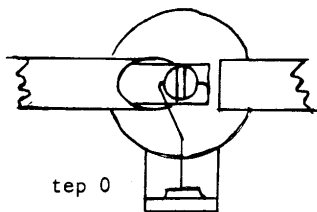
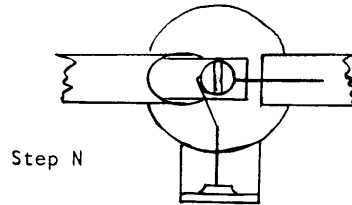
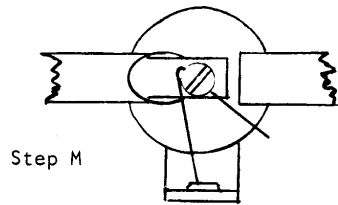
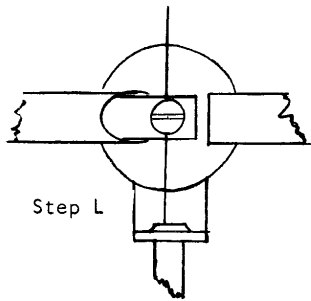


Illustration #4

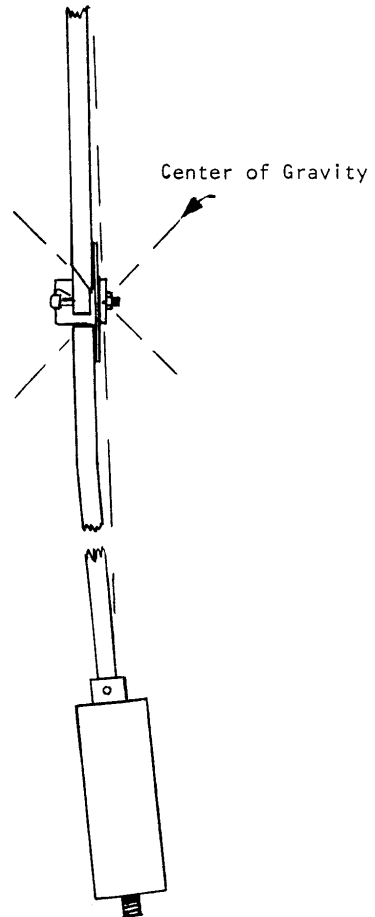


Illustration #2
Top View

HOW TO MAKE ADJUSTMENTS - continued

- c. When the above procedure does not give enough clearance, either the motor unit is set too low in the helicopter or the rotor blades are bent. To raise the motor, loosen the set screw in the end of the universal (2-5), pull up on the motor until you have proper clearance and retighten the set screw. Note: The set screw bears on the rotor shaft housing and overtightening the screw will cause the housing to collapse and bind the shaft.
2. Balancing the helicopter.
 - a. Before checking helicopter balance, the following conditions should be present:
 1. When at rest the helicopter should set squarely on the landing field with the tilt stop lightly touching the shaft. During all balance checks the rotor shaft should be near the vertical position. Check for suspension binds by grasping the counter balance arm slowly moving the helicopter arm up and down. At all points in the arc the helicopter should hang like a pendulum with the skids parallel to the surface. If a bind appears check the suspension forks for alignment and the control torsion arm for adequate clearance from the boom parts. The torsion arm must be free to both rotate and slide in and out of the boom to compensate for geometry changes. The vertical push rod could cause trouble if the fillister head screw that acts as a lever arm is not free to rotate or is screwed into the torsion arm too far.
 2. Free movement of the boom in the vertical plane is absolutely essential. Check for vertical movement binds by releasing the helicopter at various altitudes and observing its down-

HOW TO MAKE ADJUSTMENTS - continued

ward movement. If a bind is apparent first check the pivot cover (1-6) to make sure none of the moving parts contact the housing. Next remove the pivot cover cap and check the fillister head screw for free rotation and the vertical push rod for proper shape (the slot in the fillister head screw should be approximately vertical at all times). If the center of gravity of the boom is not centered directly under the pivot bushing, the boom will tend to rotate around its longitudinal axis causing a bind between the mounting bracket on the top of the vertical shaft and center plate of the boom. To correct this bind refer to illustration #2.

- b. Check for balance by raising the helicopter to its upper limit by hand and then releasing. It should drop smoothly to the surface and then bounce once between $\frac{1}{2}$ and 1 inch. Adjust the counterweight to get the proper bounce. Next, release the helicopter from a height of $\frac{1}{2}$ inch. The helicopter should drop smoothly to the surface and not bounce.
3. Adjusting control limit stops.
 - a. Power Control
 1. The lower stop should always be set so that when the power handle is released the control lock arm lines up with the slot in the control lock lever (4-13).
 2. Next, loosen the potentiometer (4-8) lock nut and rotate the pot clockwise until the rotor begins to move and then turn back counterclockwise until the rotor stops. Tighten the pot lock nut. The motor should not run when the power handle is against the lower limit stop.
 3. The upper limit stop should be set so that when the power

HOW TO MAKE ADJUSTMENTS - continued

handle is pulled up slowly the helicopter reaches maximum altitude with the counter balance arm about $\frac{1}{2}$ " above a corner of the control tower. When the handle is pulled up rapidly to full power, the boom should hit the tower roof corner lightly. Firm contact of the boom to the tower must be avoided to prevent damage.

b. Directional control

1. First equalize the control handle springs so that when the handle is released from any position it will return to a center position where the control lock arm lines up with the slot in the control lock lever (4-13). Adjust by bending the spring loop arm on the under side of the control shaft.
2. Check the neutral hovering position by pulling up on the power handle without touching the direction handle. The helicopter should rise vertically and hover with little or no horizontal movement. Adjust the length of the directional control horizontal push rod (4-12) to get the correct hover by turning the clevis (4-11).
3. Next check forward and backward limit stops by moving the control handle slowly to the limit in each direction. At the same time observe the tilting movement of the helicopter motor. The motor should reach maximum tilt (when it touches the helicopter body) at the same time the control arm hits the adjustable limit stop. If there is any movement apparent in the control handle beyond the point where the motor reaches maximum tilt, the stop should be reset until the motor remains slightly clear of the helicopter body.

HOW TO MAKE ADJUSTMENTS - continued

If this isn't done, the control linkage will be damaged.

Before adjusting the stops check inside the helicopter to insure that no wires have moved into a position between the motor and helicopter body and that the motor is positioned with the flat sides running across (perpendicular) to the body. Also check to see the motor is not set up too high and that the rear air scoop has not been pushed inside the body. If you cannot get satisfactory control after making these adjustments check the universal (2-5) on the helicopter for proper operation and for binds in the linkage. Most likely trouble spots are the bell crank position (3-4), vertical pushrod length, or incorrect bends in the vertical push-rod (1-3).

SPECIFIC REPAIR PROCEDURES

Replacement of relays, coin drops, lights and counters follow standard practices and any experienced repairman should encounter no particular problems. However, the helicopter control and support system is not conventional and the repairman must read and study all information before beginning repair work or he will probably make mistakes.

The following step-by-step procedures have been prepared for the replacement of parts that experience has shown most frequently to be done wrong.

1. Replacing vertical control push rod.
 - a. Remove back and bottom panels.
 - b. Loosen lock nut on threaded portion of the vertical control push rod (1-3) where it attaches to the swivel (3-6).
 - c. Disconnect the swivel (3-6) from the bell crank (3-4) by removing the attaching screw and bushing.
 - d. Detach the swivel from the vertical rod by turning the swivel

SPECIFIC REPAIR PROCEDURES - continued

- from the vertical rod by turning the swivel by hand. If necessary hold the threaded portion of rod with pliers.
- e. Remove the lock nut.
 - f. Remove pivot shaft collar (1-2) by loosening and sliding off end.
 - g. Carefully withdraw the vertical pivot and boom assembly from the center pivot housing (3-1) by pulling up on the center. Slide the boom pivot housing (1-6) and the top bearing off the shaft.
 - h. Remove the defective vertical push rod by cutting the top end off.
 - i. Insert new push rod from bottom.
 - j. Check the fillister head screw (1-11) to see that it rotates freely in its hole and is screwed into the brass fitting so that the end of the screw lacks about one thread from coming out the other side.
 - k. Thread the upper end of the push rod through the hole in the head of the fillister head screw.
 - l. Push the rod through the screw head until there is $\frac{1}{2}$ inch space between the threaded portion on the bottom of the rod and the fiber insulator on the bottom of the pivot shaft. See illustration #4.
 - m. Without moving the fillister head screw or push rod, insert a screw driver in the screw head and turn it approximately 130 degrees to the right (clockwise). This completes the first bend in the push rod.
 - n. Next, using needle nose pliers, select a point on the push rod approximately $\frac{1}{4}$ " below the first bend and grasp

SPECIFIC REPAIR PROCEDURES - continued

- the wire with the pliers jaws on the upper side of the point. Rotate pliers to left until a bend of about 45 degrees has been set in the wire. This should line up the vertical portion of the push rod with the center of the screw head.
- o. Next bend down the end of the rod protruding from the fillister head screw so that the rod will not slip out and cut off the excess.
 - p. Check your work by viewing from one end of the boom. No sharp bends or kinks should be visible in the rod. When the pivot shaft is vertical and the fillister head screw is horizontal there should be approximately $\frac{1}{4}$ " plus or minus $\frac{1}{16}$ " clearance between the fibre insulator and threaded portion of the push rod.
 - q. Slide the boom pivot housing into position (1-6) on the vertical shaft.
 - r. Check to make sure the bottom pivot bearing is not installed and the top bearing is installed.
 - s. Either prop the brushes (3-8) out of the way by putting a $\frac{1}{2}$ " wood dowel underneath them or remove the brush block assembly. Be careful not to put a permanent bend in the brush springs.
 - t. Insert the pivot shaft, sliding it carefully through the top bearing until the pivot housing (1-6) seats on the bearing. Insert the lower bearing.
 - u. Reinstall the pivot shaft collar (1-2) and tighten set screw after double checking to make sure the shaft is all the way down. After tightening check for vertical movement

SPECIFIC REPAIR PROCEDURES - continued

- of the pivot shaft (up to 1/32" is o.k.) and free rotation of the boom assembly. Reinstall the brush assembly. Check to insure contacts are centered on slip rings.
- v. Install the lock nut on the threaded portion of the rods turning it up to the upper limit of the threads. Next, thread the control swivel (3-6) on loosely. Reconnect the bottom of the swivel to the bell crank using the screw and bushing. With the bell crank sides parallel to the bell crank mount, rotate the swivel until the helicopter rotor shaft is vertical. Tighten the lock nut. Be careful not to twist the push rod. If necessary grip the threaded portion of the rod or swivel with pliers while tightening.
- w. If all work has been done correctly, when the directional control handle is vertical, the bell crank will be parallel with its mount, the fillister head screw will be horizontal and the helicopter rotor shaft vertical.

2. Boom Replacement

- a. Remove pivot and boom assembly in accordance with procedure 1, steps "a" through "g".
- b. Remove fillister head screw by pulling down on the push rod until the screw is vertical and then rotating the push rod.
- c. Disconnect electrical lead wires from helicopter.
- d. Spread suspension fork with fingers so ends are free from mount block. Remove helicopter, being careful to disengage the control torsion rod (1-12) from the universal(2-5).
- e. Pull out the torsion rod and electrical lead wires.
- f. Remove the pivot nut.

SPECIFIC REPAIR PROCEDURES - continued

- g. Assembly of the boom is done in reverse order. Be sure to check for binds in the pivot and torsion rod while assembling.

3. Helicopter motor replacement

- a. Motors can be replaced while the helicopter is attached to the boom. First remove the rotor by grasping the shaft with pliers and turning the rotor counter clockwise as viewed from the top.
- b. Remove the windshield by pinching the two sides lightly with thumb and second finger. Push in on top of the windshield with the index finger and lift up.
- c. Loosen the set screw (2-6) in the end of the universal (2-5).
- d. Work the motor down slowly, moving it as necessary to avoid objects in the cockpit.

4. Cat Whisker Replacement.

- a. Remove old cat whiskers by simply pulling them out.
- b. The short end of the new cat whisker should have several bends (in the manner of corrugations) to provide the friction necessary to hold it in place within the brass tube. If there are none, you may bend them yourself using needle nose pliers.
- c. Insert the end of the whisker in the tube with needle nose pliers and using a series of short strokes (about 1/16" at a time) push the whisker in until the spring coil touches the side of the helicopter.
- d. Next, bend the whisker until it is perpendicular to the side of the helicopter.
- e. Move the helicopter to all the contact points the whisker is suppose to touch. Cut off the whisker so that about $\frac{1}{4}$ "

SPECIFIC REPAIR PROCEDURES - continued

of the whisker extends beyond the farthest contact point.

MOVING PROCEDURES

No preparation is necessary for normal movements within a city provides the machine is kept vertical, is transported in a softly sprung truck (example is conventional $\frac{1}{2}$ ton pick-up) and care is taken to avoid sharp shocks. The legs may be removed for convenience. We recommend the counterweight be removed to insure the boom will not be bent if unforeseen bumps are experienced.

For longer hauls or rides in heavy duty trucks the counterweight should be removed, (leave the collar and nut on to mark the position) and the helicopter fastened down to the board. Place a pad under the landing surface and use a rubber band between the eyelets to hold it down. It only takes a few minutes and virtually eliminates the possibility of damage to the mechanism.

When you are moving the Helicopter Trainer and come to a door that is too narrow, use the following procedure to get through:

1. Remove legs and set base on floor.
2. Remove the back panel.
3. Remove the roof (4 screws, one in each corner).
4. Slide the three glasses out.
5. Pick up the base, tilt slowly to one side and jackknife it through the door frame.
6. Re-assemble when you have reached your destination.

PARTS LIST

Important, Note: Part numbers are not provided for standard hardware type items which may be purchased locally.

Assembly 1, Central Boom and Pivot

Part No. 1-1 Vertical pivot shaft with communtator rings and wires installed.

PARTS LIST - continued

Part No.	1-2	Pivot shaft collar
	1-3	Vertical control push rod
	1-4	Counterweight boom collar
	1-5	Counterweight
	1-6	Boom pivot housing
	1-7	Boom pivot housing cap
	1-8	Teflon washer
	1-9	Bushing
	1-10	Boom
	1-11	Control torsion arm lever (drilled fillister head screw).
	1-12	Control torsion arm

Assembly 2, Helicopter

Part No.	2-1	Basic helicopter painted, with windshield and control block installed, no motor or whiskers.
	2-2	Cat whisker
	2-3	Motor complete with extended shaft and housing
	2-4	Propeller (metal)
	2-5	Universal joint
	2-6	Set screw
	2-7	Helicopter windshield

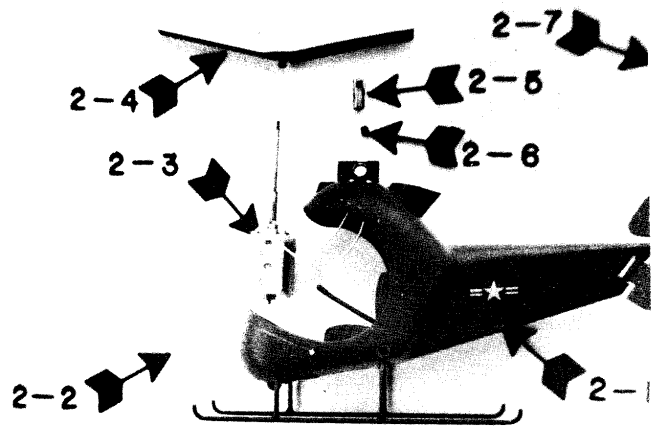
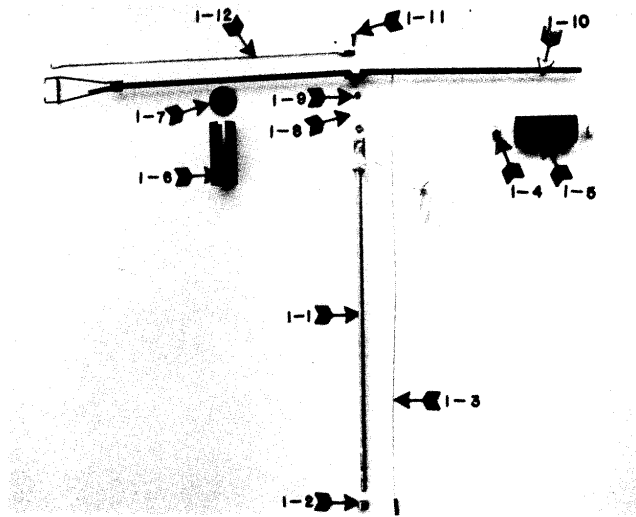
Assembly 3, Central Pivot Housing

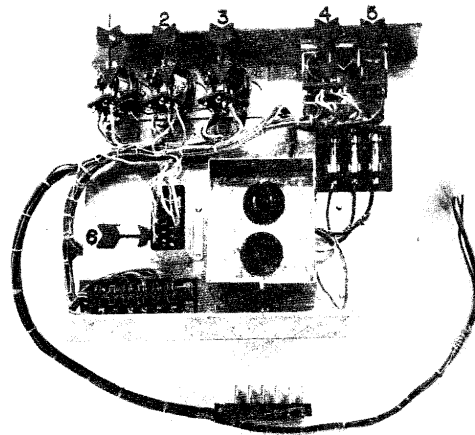
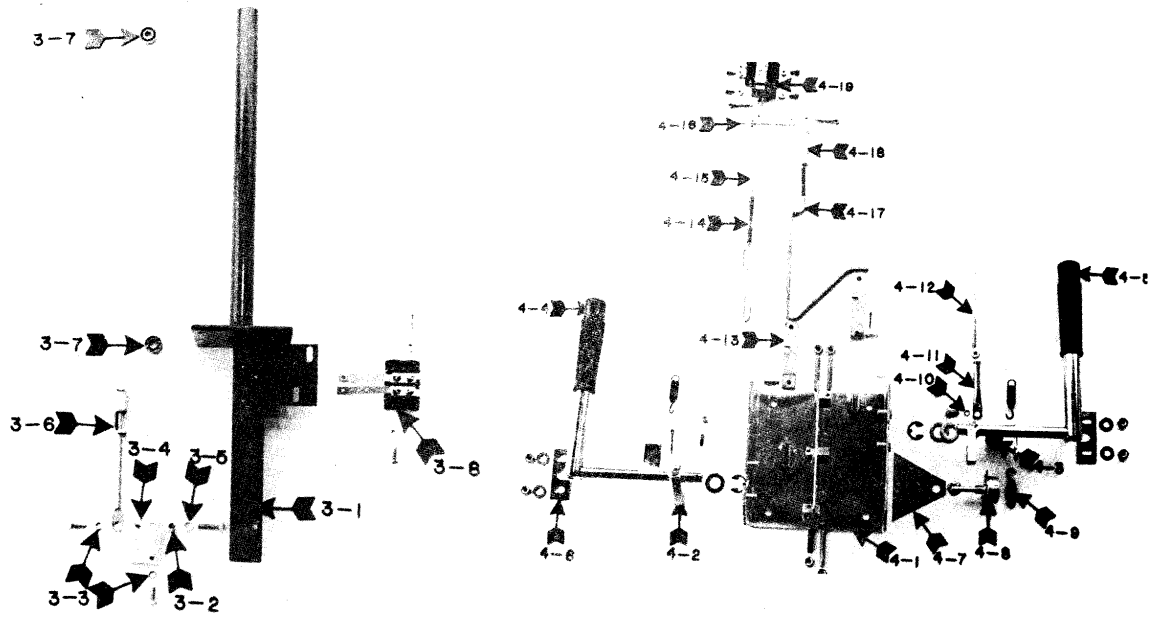
Part No.	3-1	Center pivot housing
	3-2	Bell crank bushing
	3-3	Clevis bushing (2 required)
	3-4	Bell crank
	3-5	Bell crank spacer
	3-6	Swivel, directional control
	3-7	Pivot bearings
	3-8	Central pivot brush assembly

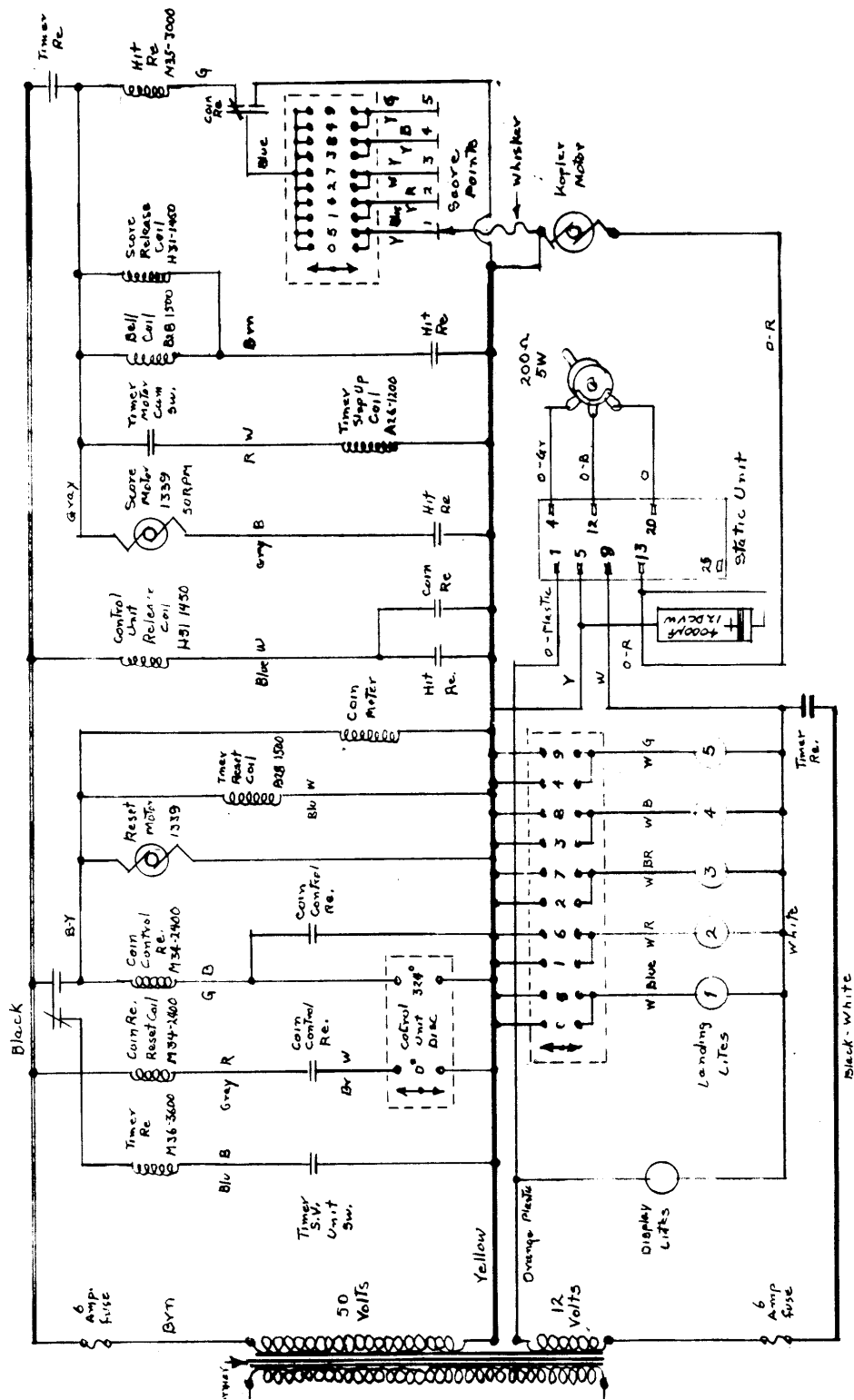
PARTS LIST - continued

Assembly 4, Controls

Part No.	4-1	Control base
	4-2	Power control handle and shaft
	4-3	Directional control handle and shaft
	4-4	Power control grip - red
	4-5	Directional control grip - black
	4-6	Control shaft hold down plate (2 required)
	4-7	Potentiometer mount
	4-8	Potentiometer
	4-9	Control handle return spring (3 required)
	4-10	Clevis bushing
	4-11	Directional control push rod clevis
	4-12	Directional control horizontal push rod
	4-13	Control lock (2 required)
	4-14	Control lock spring
	4-15	Control lock "S" hook (2 required)
	4-16	Control lock toggle link
	4-17	Control lock rod
	4-18	Control lock clevis
	4-19	Control lock solenoid

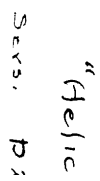






"Helicopter"

Serv. P2001 R01500 6-68



Sev. 10

